LOW DENSITY CELLULAR CONCRETE VOID FILLING

The Need

In January 1997, a demonstration was successfully completed comparing vessel segmentation, which is Fernald's baseline approach for the preparation of non-recyclable vessels for disposal in Fernald's on-site disposal facility (OSDF), and the innovative approach of void filling. Critical to the design and operation of Fernald's OSDF are provisions to protect against subsidence of the OSDF's cap. Subsidence of the OSDF's cap would create depressions in which rain water can collect. Ultimately these depressions could provide a leakage pathway for rain water into the OSDF. If material with void volumes is placed within the cell it will ultimately translate into subsidence of the OSDF's cap, because eventually the voids will collapse in upon themselves as the cell's fill material and D&D debris drop into the void. To prevent this sequence of events from occurring, vessels with void volumes are segmented such that all that is placed in the OSDF are the segmented pieces of the original vessel.

Figure 9. Low Density Cellular Concrete Void Filling, Pacific International

The Technology

The selected alternative to vessel segmentation was void filling. The concept behind this technology application was that vessel void spaces would be filled with a pumpable material that once solidified, would be capable of withstanding the compressive load resulting from the overburden. Thus should the vessel's wall/shell degrade (i.e., rust) and fail over time, the solid void filling media would prevent subsidence of the OSDF's cap. This particular demonstration used a low-density cellular concrete (LDCC) as the void filling media. The LDCC is generated by introducing into the cement-water mix (no aggregate), an aerated protein based surfactant (air bubbles), which greatly reduces the concrete density but still provides the necessary strength. LDCC was used to minimize the weight of the filled vessel so that it could be easily moved.

The Demonstration

This demonstration was conducted in Fernald Building 30B adjacent to Building 1A. Three process vessels from Building 1A were void filled using LDCC. The vessels were removed from the Plant 1 structure after transite removal and setup in Building 30A for the demonstration. The baseline, In-situ segmentation of four process vessels was conducted in Building 1A.

Results

After normalizing for the total volume and effort involved in the baseline versus the void filling technologies, it was calculated that 59 cubic feet of vessels could be void filled per day versus only 27 cubic feet segmented. Assuming that there were 1000 cubic feet of vessels in a structure, it would take approximately 37 days to segment them versus only 17 days to remove and void fill them. On a purely economic basis, not taking advantage for a potentially shortened schedule, the data collected at the Fernald LSDDP indicates this technology offers an 11% cost savings over the baseline when the total void filling effort involves an aggregate void volume of at least 1000 cubic feet. Void filling significantly reduces the risk to laborers from work related injuries by reducing the work effort (cutting, rigging/material handling, work above the floor) by shortening the schedule. It also significantly reduces the levels of airborne contaminants resulting from the torch cutting of vessels painted with lead-based paint. Perhaps the greatest benefit to be derived from this technology, which was not included in the cost analysis, is the potential to significantly reduce a facilities overall D&D schedule. In situ segmentation of the baseline vessels required 26 calendar days. During this time no other activities were conducted in the area involved in the segmentation effort. In comparison, the vessels that were involved in the LDCC demonstrations were removed in total from Building 1A in four days.